# PROPSHAFT BOOT WITH INTEGRATED BEARING SEAL DEFLECTOR AND CLAMPLESS RETENTION

## FIELD OF THE INVENTION

**[0001]** The present invention generally relates to mechanical joints for transmitting rotary power and more particularly to a boot seal with improved sealing and coupling characteristics.

## BACKGROUND OF THE INVENTION

**[0002]** Mechanical joints for transmitting rotary power, such as an externally splined shaft that is matingly engaged to an internally splined shaft, frequently utilize a boot seal for covering the power transmitting members of the mechanical joint. Conventional boot seals include a pair of coupling portions that are coupled to the opposite sides of a body portion. The body portion is usually configured with bellows, convolutions or similar means to permit the coupling portions to move axially relative to one another. The coupling portions generally include a circumferentially-extending groove that is configured to receive a metallic or plastic boot clamp. The boot clamp is employed to retain the coupling portion to a power transmitting member of the mechanical joint (typically to an input member or an output member) secure the boot seal to the power transmitting members.

**[0003]** While such designs have generally been successful in protecting the power transmitting joint members from contact with debris and moisture, those skilled in the art will appreciate that an improved boot seal is highly desirable. In this regard, it is highly desirable that assembly of the boot seal to the power transmitting joint members be more efficient and require relatively less tooling. Furthermore, it is not uncommon for debris and moisture to travel through the open end of a boot seal where the debris and moisture contribute to wear and/or corrosion. Accordingly, there remains a need in the art for an improved boot seal which better resists the infiltration of debris and moisture through the open end of the boot seal.

## SUMMARY OF THE INVENTION

**[0004]** In one preferred form, the present invention provides a boot seal for a mechanical joint with a rotary joint member. The boot seal includes a flexible body portion and a flange end that is coupled to an end of the body portion. The flange end includes a flange seal portion, which is configured to seal against the joint member in an axial direction, and an annular lip that extends circumferentially about the seal portion and shields the flange seal portion from debris and moisture. The annular lip is preferably configured such that the debris and moisture are expelled from the area proximate the annular lip. The flange seal portion preferably resiliently and sealingly engages the rotary joint member to permit the seal boot

to be coupled to the rotary joint member without resort to conventional boot clamps.

**[0005]** Further areas of applicability of the present invention will become apparent from the detailed description provided hereinafter. It should be understood that the detailed description and specific examples, while indicating the preferred embodiment of the invention, are intended for purposes of illustration only and are not intended to limit the scope of the invention.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0006]** Additional advantages and features of the present invention will become apparent from the subsequent description and the appended claims, taken in conjunction with the accompanying drawings, wherein:

**[0007]** Figure 1 is a top plan view of a boot seal constructed in accordance with the teachings of the present invention;

**[0008]** Figure 2 is a longitudinal section view of the boot seal of Figure 1 shown in operative association with a pair of rotating joint members;

**[0009]** Figure 3 is a sectional view taken along the line 3-3 of Figure 1;

**[0010]** Figure 4 is a top plan view of another boot seal constructed in accordance with the teachings of the present invention; and

**[0011]** Figure 5 is a sectional view taken along the line 5-5 of Figure 4.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0012]** With reference to Figures 1 through 3 of the drawings, a boot seal constructed in accordance with the teachings of the present invention is generally indicated by reference numeral 10. The boot seal 10 is unitarily formed from a resilient material, such as natural or synthetic rubber or a suitable plastic, and is illustrated to include a flexible body portion 12, a coupling end 14 and a flange end 16. The boot seal 10 is shown in Figure 2 in conjunction with a mechanical joint 18 for transmitting rotary power. The mechanical joint 18 includes a first member, which is the internally splined output shaft 24 of a transfer case 22 in the particular example provided, and a second member, which is an externally splined shaft 20 that is associated with a propshaft 24a in the particular example provided. Although the exemplary output shaft 24 is illustrated to include a male splined end 26 that matingly engages a mating female splined end 28 that is formed on the splined shaft 24, those skilled in the art will understand that various other means may be employed to couple the members of the mechanical joint 18 to facilitate the transmission of rotary power therebetween. Accordingly, the particular embodiment illustrated is not intended in any way to limit the scope of the present invention.

**[0013]** Returning to Figures 1 through 3, the flexible body portion 12 is conventionally illustrated to include a plurality of convolutions 30 having angular sidewalls 32 that extend radially inward into connection at annular roots 34. The annular roots 34 form live hinges that facilitate flexure and axial movement of the

body portion 12 (i.e., compression and extension of the body portion 12) during the operation of the mechanical joint 18.

**[0014]** The coupling end 14 is coupled to a first end of the body portion 12 and is illustrated to include an annular clamp flange 40 that is sized to receive a conventional boot clamp 42, such as a boot clamp that is shown in U.S. Patent No. 3,402,436 to Oetiker, the disclosure of which is hereby incorporated by reference as if fully set forth herein. The inside diameter of the coupling end 14 is sized to engage the splined shaft 24 in a slip-fit manner. Tightening of the boot clamp 42 secures the coupling end 14 to the splined shaft 24 to thereby inhibit relative rotation therebetween. A plurality of radially extending ribs 44, which are coupled at a proximal end to the flexible body portion 12, serve to increase the strength and rigidity of the coupling end 14.

**[0015]** The flange end 16 is coupled to a second end of the body portion 12 opposite the coupling end 14. The flange end 16 is illustrated to include a flange seal portion 50 and an annular lip 52. The flange seal portion 50 is configured to create a primary seal against the output shaft 20 to guard against the infiltration of moisture or debris into the body portion 12. In the particular embodiment illustrated, the flange seal portion 50 includes an attachment portion 54 that is configured to sealingly engage a mating groove 55 that is formed about the perimeter of the output shaft 24. Due to the resilient nature of the material from which the boot seal 10 is formed, the attachment portion 54 is configured to resiliently expand over the output shaft 24 during the installation of the boot seal

10 and thereafter constrict around the outside diameter of the output shaft 24 when aligned to the groove 55 to thereby frictionally engage the output shaft 24. Construction in this manner is highly advantageous in that it eliminates the need for a conventional boot clamp. To aid the technician in installing the boot seal 10, a chamfer 56 may be formed on a leading edge 58 of the flange seal portion 50.

**[0016]** The annular lip 52 extends around the circumference of the flange seal portion 50 to thereby form a barrier that shields the flange seal portion 50 from debris and moisture that is splashed upwardly toward the transfer case 22 during the operation of a vehicle (not shown) incorporating the seal of the present invention. In the particular embodiment illustrated, the annular lip 52 is generally L-shaped, having a first portion 60, which extends generally radially outwardly from the flange seal portion 50, and a second portion 62 that is generally transverse to the first portion 60. The second portion 62, which is generally concentrically disposed about the longitudinal axis 64 of the flange seal portion 50, has an outside diameter that is preferably about twice the inside diameter of the flange seal portion 50. In the particular embodiment illustrated, a distal end 66 of the annular lip 52 extends axially away from the body portion 12 by a dimension that is about equal to a dimension by which the leading edge 58 of the flange seal portion 50 extends axially away from the body portion 12. For reasons that are discussed below, the barrier created by annular lip 52 need not have the same robustness and integrity as the seal that is created by the flange

seal portion 50 (against the output shaft 20). In the example provided, the annular lip 52 is actually spaced apart from the housing 22a of the transfer case 22. A plurality of radially extending ribs 72 interconnect the annular lip 52 and at least one, but preferably both, of the body portion 12 and the flange seal portion 50.

**[0017]** Although a sealed bearing 22b is seated in the housing 22a of the transfer case 22 to prevent the infiltration of dust and moisture into the transfer case 22, the barrier provided by the annular lip 52 provides an additional measure of protection by generally preventing most debris and moisture from reaching the seal 22c of the bearing 22b. Additionally, since the boot seal 10 rotates with the joint members of the mechanical joint 18 (i.e., the output shaft 20 and the splined shaft 24 in the example provided) during the operation of the mechanical joint 18, centrifugal force will tend to expel any debris and/or moisture that works its way between the annular lip 52, the bearing seal 22c and the output shaft 20 to thereby further ensure the integrity of the seal 22c.

**[0018]** While the boot seal has been described thus far as including a coupling end that utilizes a conventional boot clamp, those skilled in the art will appreciate that the invention, in its broader aspects, may be constructed somewhat differently. For example, the boot seal may be configured with ends that are substantially identical to the flange end. Also, as shown in Figures 4 and 5 the boot seal 10 may be formed without the radially extending ribs 72 that are shown in the above discussed embodiment to interconnect the annular lip 52 with

either or both of the body portion 12 in the flange seal portion 50. Accordingly, although the invention has been described in the specification and illustrated in the drawings with reference to a preferred embodiment, it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention as defined in the claims. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment illustrated by the drawings and described in the specification as the best mode presently contemplated for carrying out this invention, but that the invention will include any embodiments falling within the foregoing description and the appended claims.